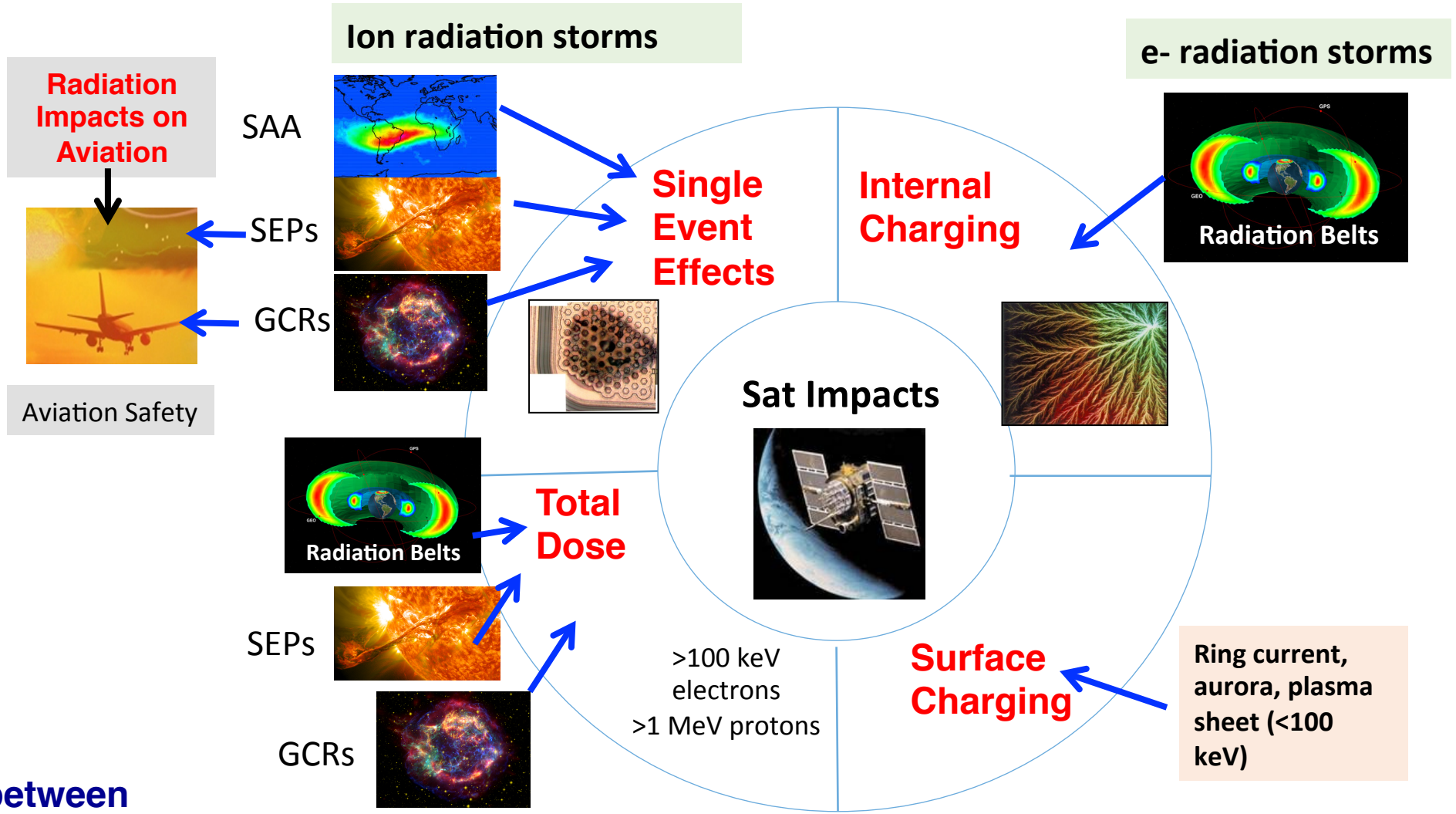
Space Radiation and Plasma Effects: Summary



- **Linking between space environment and impact (satellites and aviation)**

Mission Concept/Planning/Design Mission Launch

Mission Operations Anomaly Resolution

Space Radiation and Plasma Effects Working Group co-leads

Decided to focus on space environment models that are relevant to these effects

- Surface charging (J. Minow, N. Ganushkina, D. Pitchford)
- Internal Charging (P. O'Brien, Y. Shprits)
- Single Event Effects (M. Xapsos, P. Jiggens, J. Mazur)
- Radiation at aviation altitudes (K. Tobiska, M. Meier)
- Total Dose in solar array and electronics due to SPEs and electron enhancements (I. Jun, M. Xapsos, T. Guild)

Facilitator: Yihua Zheng and M. M. Kuznetsova

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- Physical quantities (details see next slide) for both science community and user community identified (can be easily translatable for impact assessment), proceeds with model validation efforts
- Different Metrics will be explored including the traditional ones and some new ones
  - Terrestrial model evaluation tools (e.g. Tara Jensen)
  - e.g., the median symmetric accuracy and the symmetric signed percentage bias using log ratio (Morley et al., 2018)
  - Threshold based metrics
- Surface charging validation – ongoing (Vania's presentation)
- Internal charging – planning/event selection
- Radiation effects at aviation altitudes – ongoing
- Single Event Effects: will validate rigidity cutoff models using GPS and other data (Paul and Kent's presentation)
- Total Dose: electric orbit raising (~6 months duration, O3b)
- ~5-6 papers to be submitted to Space Weather Special Issue

Quantities to be Used for Validation

Impacts	Effect Metric	Science Predictands	Time Period (Space Weather)
Surface Charging	>10 keV e- flux	>10 keV e- flux; Te; Ne	seconds
Internal Charging	>100 fA/cm^2 [100 mils]	1 MeV and > 2 MeV e- flux	24-hour, 72hr averaged
Single Event Effects	SEE rate [100 mils]	>30 MeV p+ flux; >15 MeV.cm^2.mg^{-1} LET flux	5-min, daily, weekly (worst)
Total Dose	Dose in Silicon[100 mils; 4 mils]	30-50 MeV p+ flux; >1.5 MeV e- flux 1-10 MeV p+	Daily, weekly, yearly
Aviation	Dose rate in aircraft (D-index)	2 spectral parameters (power law with rigidity)	5-min, Hourly

1 mil= 1 thousandth of an inch = 0.001 inch
[100 mils]: behind a 100 mils aluminum shielding

Papers for the special issue

1. O'Brien, T. P., et al: Using satellite anomalies to inform space weather sensor and model performance evaluations.
2. Zheng, Y., et al., Radiation and Plasma effects on space assets: metrics for tracking space weather environment performance
3. Yu, Y., V. K. Jordanova, et al., Initial results from the GEM challenge on the spacecraft surface charging environment
4. Tobiska et al., Analytical Representations for Characterizing the Global Aviation Radiation Environment based on Model and Measurement Databases, submitted
5. Ganjushkina, N. et al., IMPTAM model validation efforts and results (approximate)
6. Meier, M. et al., Calculating radiation exposure at aviation altitudes using PANDOCA (approximate)

Possible:

Jun, I., et al., The Current Status of Space Weather Products and Implications for Spacecraft Design: Total Ionizing Dose Point of View